

Report for Boss Energy:
Environmental monitoring program: EL
20/2004

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Executive summary

A water sampling program has been initiated at the China Bush oil shale bulk sample site to monitor runoff waters from the shale stockpile and rehabilitated bulk sample area. Samples have been tested for hydrocarbons and acid mine drainage contaminants. Initial results show that no hydrocarbons are present in runoff waters from the shale. Most acid mine drainage suite elements are within suggested limits for waters discharged from the bulk sample site, however concentrations of Zn are slightly elevated. Ponded water adjacent to the shale stockpile has no hydrocarbon contamination, but has relatively elevated levels of metals compared to the waters discharged from the bulk sample area. It is recommended that an ongoing sampling program should be maintained to monitor the influence of the shale stockpile and to increase the statistical validity of data.

Introduction

In April, 2008, a 1000 tonne bulk sample of Tasmanite Oil Shale was extracted and stockpiled at the China Bush Plantation site, Near Latrobe. After shale extraction, the site was rehabilitated, and the shale stockpile was retained as a store for ongoing assessment of shale processing technologies. The stockpile and rehabilitated site are within a pine plantation which was harvested before shale extraction, and re-planted shortly after. Boss Energy has initiated a monitoring program to establish some baseline information for the site, and to ensure that any potential site issues may be identified and managed appropriately.

Location

Three sites covering upstream and downstream drainage have been chosen for an initial water chemistry study of the shale stockpile and rehabilitated pit site. As the material in the stockpile is classified as an oil shale, hydrocarbons, and standard acid mine drainage suite elements have been assessed. Site 1 represents ponded drainage from the shale stockpile, site 2 represents inflow to the site, and site 3 represents outflow from the rehabilitated bulk sample area. Sites 2 and 3 are ephemeral, with little or no flow expected during summer months. Site 1 dilutes and discharges only during rain events.

Locations of sample sites are shown in figure 1. The rehabilitated pit site and stockpile are shown in figures 2-3 and sample site photos are shown in figs 4-6. Sample site details are recorded in table 1.

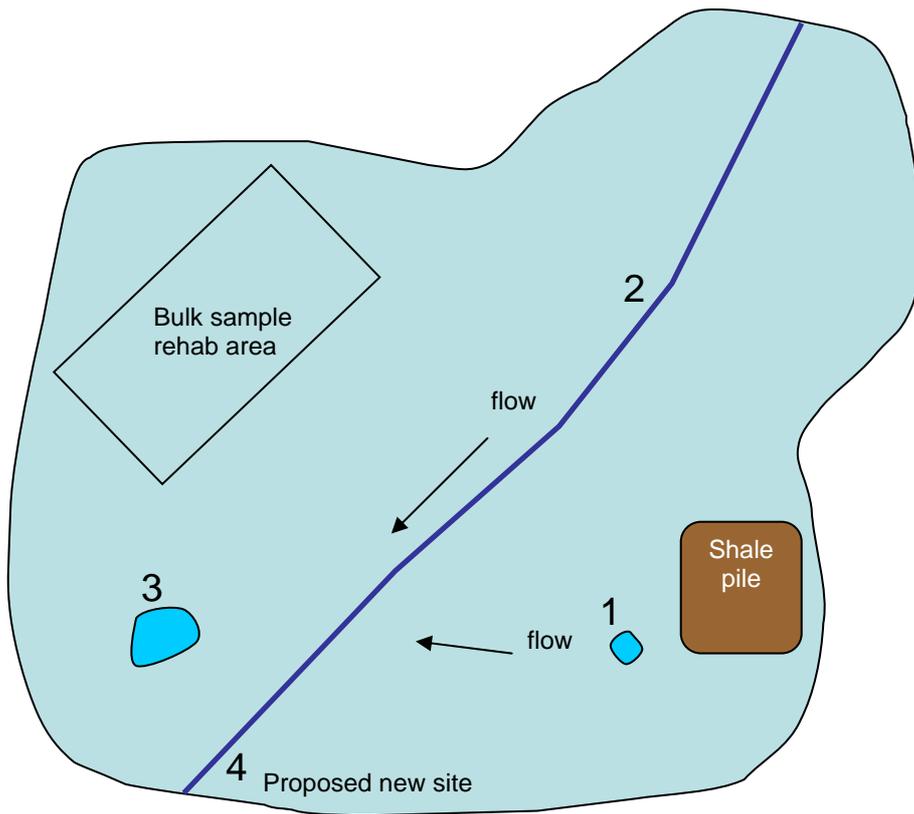


Figure 1: Schematic site diagram. Water sampling sites are labeled 1-3



Fig 2. Shale stockpile following rain event



Fig 3. Pit rehab site (background) following rain event. Water on logging track is in foreground.



Figure 4. Shale 1 sampling site



Figure 5. Shale 2 sampling site



Figure 6. Shale 3 sample site.

**Table 1: Sample site details
(coordinates WGS84)**

Water sample sites	Location	Easting	Northing
Shale 1	Shale stockpile	453012E	5425995N
Shale 2	Upstream of pit	452981E	5425958N
Shale 3	Downstream of pit	453028E	5425908N

Methods

Water samples were analyzed by Analytical Services Tasmania at their Newtown laboratory, Hobart. Initial samples were taken for hydrocarbon, alkalinity and sulphur analysis. Hydrocarbons analytical methods were TPH (total petroleum hydrocarbons), and BTEX (benzene, toluene, ethyl benzene and xylenes). Samples collected for hydrocarbon analysis were collected in glass containers from the surface of water bodies. Following initial results, the analyte suite was extended to encompass standard acid mine drainage elements.

Results

Table 2 Rainfall record for Sheffield.

Locality	Sample Date	Conditions	Rainfall (mm)	Rainfall Date
Shale1	16-Jul	standing water	21.8	14-Jul
Shale2	16-Jul	slow flow	21.8	14-Jul
Shale3	16-Jul	standing water/low flow	21.8	14-Jul
Shale1	7-Sep	standing water	43.8	5-Sep
Shale2	7-Sep	gentle flow (approx 8l/min)	43.8	5-Sep
Shale3	7-Sep	low flow	43.8	5-Sep

Source: Bureau of Meteorology

Table 3 Hydrocarbon Analysis – Analytical Services Tasmania

Analyte	Date	Shale1	Shale2	Shale3	Units
Alkalinity Total	16-Jul	<2	<2	<2	mg CaCo3/L
S Total	16-Jul	764000	1140	6440	µg/L
TPH	16-Jul	<40	<40	<40	µg/L
TPH C06-C09	16-Jul	<10	<10	<10	µg/L
TPH C10-C14	16-Jul	<10	<10	<10	µg/L
TPH C15-C28	16-Jul	<10	<10	<10	µg/L
TPH C29-C36	16-Jul	<10	<10	<10	µg/L
S Total	7-Sep	290000	860	3550	µg/L
TPH	7-Sep	<40	<40	<40	µg/L
TPH C06-C09	7-Sep	<10	<10	<10	µg/L
TPH C10-C14	7-Sep	<10	<10	<10	µg/L
TPH C15-C28	7-Sep	<10	<10	<10	µg/L
TPH C29-C36	7-Sep	<10	<10	<10	µg/L

Table 4 Acid Mine Drainage suite Analysis – Analytical Services Tasmania

Analyte	Date	Shale1	Shale2	Shale3	95% trigger ⁴	80% trigger ⁴	Units
pH	7-Sep	3.2	5.1	5.1			
Al	7-Sep	656000	697	574	0.8 ¹	0.8 ¹	µg/L
As	7-Sep	4	<1	<1	24	360	µg/L
Cd	7-Sep	9.9	<0.1	<0.1	0.2	0.8	µg/L
Cr	7-Sep	93	3	2	3.3 ¹	3.3 ¹	µg/L
Cu	7-Sep	226	1	2	1.4	2.5	µg/L
Fe	7-Sep	160000	442	427	300 ²	300 ²	µg/L
Mn	7-Sep	2300	10.9	56.2	1900	3600	µg/L
Ni	7-Sep	701	1.2	7.6	11	17	µg/L
Pb	7-Sep	1	<0.5	0.5	3.4	9.4	µg/L
U	7-Sep	14.8	<0.1	<0.1	15 ³	15 ³	µg/L
Zn	7-Sep	2210	<1	17	8	31	µg/L

¹Al, Cr: low reliability data.

²Fe: insufficient data Canadian Guideline used by ANZECC as indicative

³WHO provisional guideline for drinking water, assuming 2l of water consumed by 70kg adult per day, source: WISE website.

⁴Trigger values represent expected protection for 80% and 95% of species in slightly to moderately disturbed ecosystems (ANZECC guidelines).

Discussion

Results shown in Table 3 suggest that there is no measurable hydrocarbon residue present in waters near the test pit or the oil shale stockpile, indicating that the shale does not readily break down and release hydrocarbons. Elevated levels of sulphur in waters at the shale stockpile are consistent with the breakdown of diagenetic pyrite within the shale and enclosing sediments. Sulphur from sulphide breakdown (such as pyrite, FeS₂) may result in acidic waters that can transport some metals associated with acid mine drainage. Elevated sulphur measured at site 2 is most likely due to soil disturbance in the rehabilitation area with contribution from forestry operations. Ground disturbance from forest harvesting machinery exposing sulphide bearing rock in this area was noted before Boss Energy operations commenced.

Results from samples submitted to assess for metals present in runoff waters are shown in Table 4, along with environmental trigger values for initiation of water quality management from ANZECC guidelines. At this stage, the ANZECC figures have been included for comparison only, as the guidelines are intended for slightly to moderately disturbed ecosystems. The Pine plantation area at China Bush is arguably a heavily disturbed ecosystem and there are many site specific issues which may modify contaminant behaviour and acceptable limits. Note that the oil shale is not a metalliferous rock comparable to massive sulphides that are commonly associated with acid mine drainage issues.

Table 4 shows elevated levels for all analytes at site 1 (shale stockpile), relative to sites 2 and 3. This is partly due to site 1 being a static point source at the stockpile bund, with no flowing water at the time of sampling, so is not representative of diluted discharge. Results are consistent with leaching of trace sulphides within the shale. Site 3, representing the outflow from the bulk sample site, has results for most analytes within guideline levels, with the exception of Al, Cu, and Zn. It should be noted that the inflow level of Al is higher than the outflow value, and that both are high relative to the guideline. Also, the inflow level of Cu at site Shale 2 is near the threshold value.

Recommendations

Data presented here are preliminary, being from only two sample sets, and should be backed up by an ongoing program to assess any seasonal patterns, and give statistical relevance. At this stage data does not suggest that there is an issue with combined discharged water quality at the bulk sample site.

Water sampling results to date will be discussed with environmental management staff from Mineral Resources Tasmania, and advice should be taken whether any precautionary remediation action is necessary at the shale stockpile. The water sampling program should be extended to better assess the quality of waters leaving the sample and stockpile site by introducing a further monitoring station below sample site 3, and including further samples from the China Bush Plantation area.

References:

Australian and New Zealand guidelines for fresh and marine water quality, Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand, October, 2000.

World Information Service on Energy (WISE) website, www.wise-uranium.org